

CONTENTS

Abstract	1
Introduction	2
Study Methods.....	3
Sampling and Analysis for Water-Quality Characteristics	5
Field Observations.....	5
Phytoplankton-Chlorophyll Concentration	5
Lake Color.....	5
Dissolved Organic Carbon Concentration.....	8
Analytical Quality Assurance.....	8
Quality Assurance of Volunteer Data	9
Thematic Mapper-Based Assessment of Water Quality and Trophic State.....	13
Secchi Disk Transparency and Phytoplankton-Chlorophyll Concentration.....	13
Lake Color and Dissolved Organic Carbon Concentration	15
Thematic Mapper-Based Assessment of Macrophyte Distributions	16
Field-Mapping of Macrophyte Distributions	16
Digitization and Processing of Field Maps	17
Image Interpretation	18
Observed Versus Predicted Macrophyte Distributions	19
1996 Predictions Based on 1996 Interpretations	19
1997 Predictions Based on 1997 Interpretations	19
1996 Predictions Based On 1997 Interpretations	19
Summary and Conclusions.....	26
References Cited	27

FIGURES

1. Map showing locations of study lakes and Landsat-5 Worldwide Reference System paths and rows for Massachusetts	6
2. Example of field form used in volunteer field-data collection program	10
3. Graphs showing relations between volunteer and U.S. Geological Survey staff measurements of (A) Secchi disk transparency; (B) phytoplankton-chlorophyll concentration; (C) color; and (D) surface-water temperature	12
4, 5. Graphs showing:	
4. Relations between Secchi disk transparency and phytoplankton-chlorophyll concentration in Massachusetts lakes in (A) 1996; (B) 1997; and (C) 1998	14
5. Relations between color and dissolved organic carbon concentration in Massachusetts lakes	16
6. Graphs comparing observed (field-mapped in summer 1996) and predicted (interpreted from July 1996 Thematic Mapper data) areal coverages of four aquatic macrophyte cover classes coverages in 12 Massachusetts lakes	20
7. Maps showing observed (field-mapped in summer 1996) and predicted (interpreted from July 1996 Thematic Mapper data) areal coverages of four aquatic macrophyte cover classes coverages in Whitehall Reservoir, Hopkinton, Massachusetts	21
8. Graphs comparing observed (field-mapped in summer 1997) and predicted (interpreted from August 1997 Thematic Mapper data) areal coverages of four aquatic macrophyte cover classes coverages in 12 Massachusetts lakes	22
9. Maps showing observed (field-mapped in summer 1997) and predicted (interpreted from August 1997 Thematic Mapper data) areal coverages of four aquatic macrophyte cover classes coverages in Thompson Pond, Spencer, Massachusetts	23

10. Graphs comparing observed (field-mapped in summer 1996) and predicted (interpreted from August 1997 Thematic Mapper data) areal coverages of four aquatic macrophyte cover classes coverages in 12 Massachusetts lakes	24
11. Maps showing observed (field-mapped in summer 1996) and predicted (interpreted from August 1997 Thematic Mapper data) areal coverages of four aquatic macrophyte cover classes coverages in East Brimfield Reservoir, Brimfield and Sturbridge, Massachusetts.....	25

TABLES

1. Thematic Mapper spectral bands	3
2. Massachusetts lakes for which the distributions of floating, emergent, and submerged macrophytes were mapped in 1996, 1997, and 1998 for calibration of Landsat-5 Thematic Mapper imagery	8
3. Lakes sampled by Massachusetts Water Watch Partnership volunteers concurrently with U.S. Geological Survey staff for chlorophyll concentration, Secchi disk transparency, color, and water temperature in 1997 and 1998	11
4. Landsat-5 Thematic Mapper scenes used to assess water quality and trophic state of Massachusetts lakes	13
5. Thematic Mapper spectral bands and combinations of bands used as models to test for correlations with water-quality and trophic-state data for Massachusetts lakes.....	15
6. Massachusetts lakes sampled in 1996, 1997, and 1998, and numbers of measurements of water-quality characteristics used to calibrate Landsat-5 Thematic Mapper imagery.....	31
7. Lake-water-quality data collected within 24 hours of Landsat-5 Thematic Mapper imaging of the lakes, and haze-corrected digital numbers corresponding to the station locations in the images.....	37

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATED WATER-QUALITY UNITS

CONVERSION FACTORS

Multiply	By	To obtain
centimeter (cm)	0.3937008	inch (in.)
cubic meter (m^3)	264.17205	gallon (gal)
cubic meter (m^3)	35.31467	cubic foot (ft^3)
hectare (ha)	2.471	acre
kilometer (km)	0.62137	mile (mi)
meter (m)	3.280840	foot (ft)
milliliter (mL)	0.00026417	gallon (gal)
Water temperature is reported in degree Celsius ($^{\circ}C$), which can be converted to degree Fahrenheit ($^{\circ}F$) by the following equation:		
$^{\circ}F = 1.8 (^{\circ}C) + 32$		

Very small units of length are reported in millimeters (mm), micrometers (μm), or nanometers (nm). One centimeter equals 10 mm, 1 mm equals 1,000 μm , and 1 μm equals 1,000 nm.

VERTICAL DATUM

Sea level: In this report, “sea level” refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

ABBREVIATED WATER-QUALITY UNITS:

Chemical concentration is reported in milligrams per liter (mg/L) or micrograms per liter ($\mu g/L$). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as mass (milligrams) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter. For concentrations less than 7,000 mg/L, the numerical value is the same as for concentrations in parts per million. Specific electrical conductance of water is reported in microsiemens per centimeter at 25 degrees Celsius ($\mu S/cm$). Color is reported in platinum-cobalt units (PCU).